

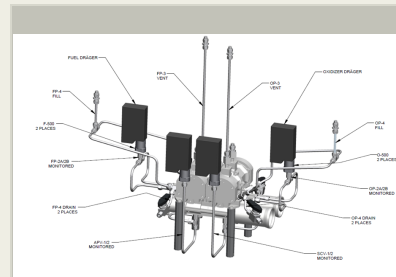
Project Introduction

The objective of this project is to characterize/determine the conditions under which propellant vapor migrates/permeates past the Orbital Maneuvering Subsystem Engine (OMS-E) series valve ball valve pinion shaft seals into the series valve actuators. Initial testing was performed in fiscal year (FY) 2012 and continued in FY 2013.

Evidence of nitrogen tetroxide (NTO) and monomethylhydrazine (MMH) propellant vapor leakage across the primary and secondary shaft seals of the four OMS-E series valve ball valve pinions have been found on nearly all OMS engines processed at the NASA White Sands Test Facility since 1996. This leakage results in various forms of internal damage to series valve ball valve pinions and actuator assembly components. Two in-flight anomalies occurred during Shuttle flight history (STS-91 OMS-E serial number [S/N] 107; and STS-101 on OMS-E S/N 111) that were direct results of propellant vapor leakage. Testing was performed in FY 2012 and 2013 to attempt to characterize/determine the conditions under which the vapors migrate/permeate past the redundant (primary and secondary) shaft seals on the ball valve pinions and into the actuator housings. In FY 2012 a "simple soak" test was performed in which NTO and MMH were introduced into their respective cavities in a flight series valve and vapor break-through monitored downstream of the primary and secondary shaft seals of each of the four ball valves using vapor detection devices. The follow-on testing performed in FY 2013 focuses on the MMH part of the series valve. In this test, MMH is introduced into the cavity between the fuel ball valves, the cavity pressurized to 250 pounds per square inch gage (psig), and monitoring performed downstream of the primary and secondary shaft seals using vapor detection devices. FY 2012 soak tests resulted in evidence of NTO vapor permeation past the primary and secondary shaft seals of the oxidizer ball valves in 2.5 and 18.5 hours respectively. While MMH vapor permeation was measured at the primary shaft seal locations of the fuel ball valves in 1.5 hours, no evidence of permeation past the secondary shaft seal was measured after 6 weeks of data logging. This resulted in the follow-on test in FY 2013 to add pressurization of the fuel ball valve cavity to determine if this would result in MMH vapor measurements downstream of the fuel ball valve secondary shaft seal locations. FY 2013 testing will be completed by September 2013 and results compiled in a test report.

Anticipated Benefits

Understanding conditions associated with OMS-E series valve shaft seal leakage will be beneficial to MPCV Program. The MPCV mission duty cycle will differ from that of the Space Shuttle's. Characterizing shaft seal leakage could aid in assessing potential risks with OMS-E use in a different mission duty cycle. This information could also provide data for use by NASA and commercial industry in future series valve derivation designs.



Project Image Follow-On Shaft Seal Evaluation for Future OMS Engine Series Valve Derivations

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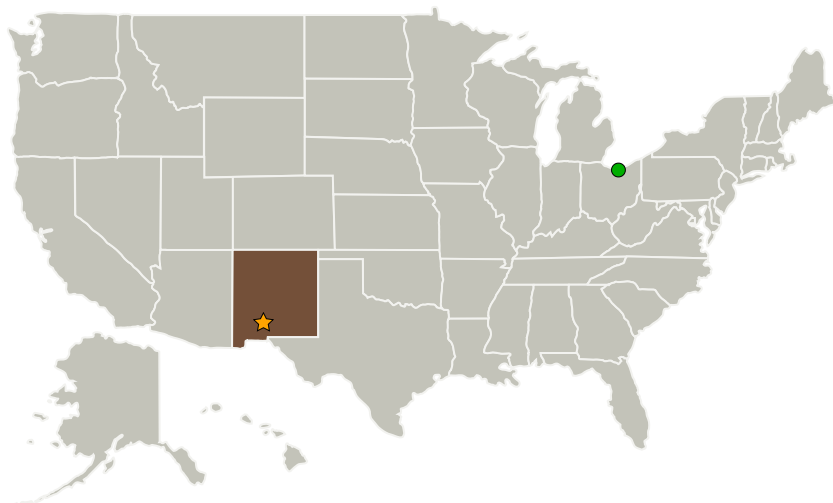
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Follow-On Shaft Seal Evaluation for Future OMS Engine Series Valve Derivations

Completed Technology Project (2011 - 2013)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ White Sands Test Facility(WSTF)	Lead Organization	NASA Facility	Las Cruces, New Mexico
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas

Primary U.S. Work Locations

New Mexico

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

White Sands Test Facility (WSTF)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Nicholas L Buntain

Principal Investigator:

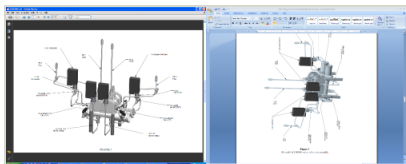
Nicholas L Buntain

Follow-On Shaft Seal Evaluation for Future OMS Engine Series Valve Derivations

Completed Technology Project (2011 - 2013)

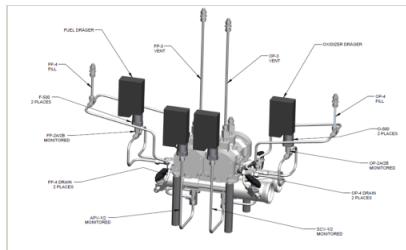


Images



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Project Image Follow-On Shaft Seal Evaluation for Future OMS Engine Series Valve Derivations
(<https://techport.nasa.gov/image/2198>)

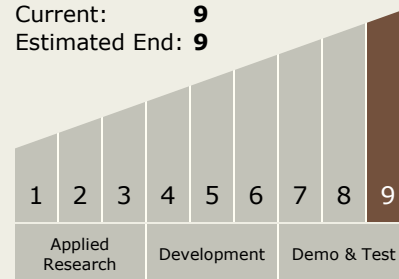


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Project Image Follow-On Shaft Seal Evaluation for Future OMS Engine Series Valve Derivations
(<https://techport.nasa.gov/image/2199>)

Technology Maturity (TRL)

Start: 9
Current: 9
Estimated End: 9



Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.1 Integrated Systems and Ancillary Technologies